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THE COMPLETE WORKS OF TYCHO BRAHE.

Tychonis Brahe Dani Opera Omnia. Edidit I. L. E. Dreyer. Tomus I. Pp. lix+320. (Copenhagen: Gyldendalske Boghandel Nordisk Forlag, 1913.)

PERHAPS one's first sensation on handling this beautiful volume is one of surprise that three centuries have been allowed to pass after Tycho's death before his writings were given to the world in a collected form; for he took a notable part in building the structure of modern astronomy. He was the first to realise the imperfections of the existing solar and planetary tables, and the fact that their improvement needed prolonged observations with larger and more carefully designed instruments than any that had yet been employed; he fortunately had the skill to design these, and the means to purchase them. Thanks to the bounty of Frederick II., he was enabled to found Uraniborg Observatory, where sun, moon, planets, and stars were observed assiduously for twenty years.

The planetary observations led Kepler to the enunciation of his three laws, those of the moon led Tycho himself to detect the variation and annual equation, also the oscillatory changes of the node and inclination; those of the sun led to the detection of atmospheric refraction, and an approximate measure of its amount. Those of comets showed, by the minuteness of their diurnal parallax, that they were much more remote than the moon, and hence that they were not vapours in our own atmosphere, as many had supposed, but belonged to the planetary sphere. His observations of the fixed stars were far more precise than any previous ones, so that according to Dr. Dreyer the probable error of his standard right ascensions is only 24″; thus we may reasonably conjecture that if Tycho had lived a few years later, and known of the telescopic method, his results might be of utility even in our day.

The present reprint is under the auspices of "Det Danske Spreg og Litteratur Selskab," which has been fortunate in securing the services of Dr. Dreyer as editor. The task is evidently a labour of love with him, as he has made a special study of Tycho's life, having written his biography in 1890; he has written a Latin preface of fifty-nine pages in the present work, giving a biographical outline and a summary of the astronomical achievements; the fuller biography should however, be read by all serious students of his life.

Mr. G. A. Hagemann is generously bearing the cost of the publication of the collected works, which must be considerable, as it is being carried out in a sumptuous manner, with very large, clear type on thick, strong paper, and will run into several volumes.

The heavens themselves signalised in a brilliant manner the advent of Tycho by the outburst of Nova Cassiopeiae in 1572. The memoir, "De Nova Stella," was the first of his published writings, and appropriately begins the collection. "Last year, on the evening of November 11, while contemplating the stars, according to my custom, I observed a new, remarkably bright one nearly overhead. And since from my boyhood all the stars were perfectly familiar to me (such knowledge is not difficult to acquire) it was certain that there had not been even a faint one in that position, much less one of surpassing splendour." Mistrusting his own eyes, he quickly got his neighbours to verify the discovery, which appeared more startling to him than to us, since he knew of no parallel except the star of Hipparchus.

He diligently observed the position of the Nova at various hour-angles, and after some months' observation satisfied himself that it had neither proper motion nor diurnal parallax (on his geocentric hypothesis annual parallax was not to be expected), so he rightly concluded that it belonged to the sphere of the fixed stars; the fact that it scintillated confirmed this view. He estimated its bulk as many hundred times that of the earth, no doubt thinking himself very daring.

His notes on the magnitude and colour are interesting, to compare with those on modern Novæ. In November, 1572, the Nova was much brighter than Venus, so that many people saw it in full daylight; at that time its colour was compared to that of Jupiter. The brightness in December was equal to Jupiter, in February and March to a star of the first magnitude, in May to one of the second. The colour became red like Mars or Aldebaran; later still it became livid like Saturn.

The astrological significance of the Nova is fully discussed; Tycho made some lucky hits; in the next century many people saw in the career of Gustavus Adolphus a striking fulfilment of the horoscope based on the Nova.

The volume before us also contains the horoscopes of the three sons of Frederick II.: Christian, Ulrich, and Hans. Dr. Dreyer notes that astrology cannot be omitted if we desire to enter fully into the thought of that age, and that Tycho could not refuse to draw up these horoscopes when the king, his patron, requested him to do so. Also, belief in planetary influence seems less unreasonable in the case of those who accept

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the geocentric hypothesis. Tycho seems to have had some faith in his predictions, but he regarded them rather as warnings of evil tendencies to be resisted, or good ones to be encouraged, than as hard and fast determinations of inevitable destiny. It is rather pathetic to remember that when the eldest prince ascended the throne as Christian IV., he withdrew all Tycho's emoluments, and treated him with such marked coldness that Tycho was glad to leave Denmark altogether, and end his days in exile in Bohemia.

The remaining matter in the volume is an oration on the teaching of mathematics, and a short treatise on practical trigonometry. Tycho had access to seven-figure tables of the natural functions, and made use of the formulæ transforming products of sines and cosines into sums of the same, to save multiplication, logarithms not having been invented.

It is one of the advantages of a verbatim reprint that it satisfies our curiosity on such small matters of procedure, and helps us to realise the everyday life and thought of astronomers of distant ages.

THE RISE AND GROWTH OF BOTANY IN THE UNITED KINGDOM.

A History of Botany in the United Kingdom from the Earliest Times to the End of the Nineteenth Century. By Dr. J. Reynolds Green. Pp. xii+648. (London: J. M. Dent and Sons, Ltd., 1914.) Price 10*s*. 6*d*. net.

MANY British and Irish botanists have been anticipating the appearance of Prof. Reynolds Green's history of the development of their science within the United Kingdom, but its reception cannot but be accompanied with feelings of sincere regret that the author is no longer with us. Indeed, he was seriously ill during much of its preparation, and one should not lose sight of this while perusing its pages. His friend, Prof. Harvey-Gibson, undertook the duty of seeing the work through the press, though, as he states in an appendix to the preface, he has refrained from editing it in any way.

As anyone who is familiar with Green's writings would be led to expect, the book is well arranged, lucid, and clearly written, and it provides an excellent general description of the rise and development of the science of botany amongst us Opening with a summary of the work of the old writers of herbals, the book goes on to trace the varied phases of the newer advances, the use of botanic gardens, and the recognition and growth of the subject at the universities; it also discusses the more recent ramifications of botany and its points of contact with kindred sciences. A considerable portion of the volume is devoted to an account of the activities of modern and still living botanists. It is full of generous appreciation of the work of his contemporaries, but Green, with characteristic modesty, is almost silent on his own important contributions to vegetable physiology.

We could wish to give a measure of praise to the book more full than mature reflection enables us to do. It is admirable up to a point, and one must remember the disadvantages under which its author laboured, failing health and severe family bereavement, during its production. Without doubt, had Green been spared to see the whole work through its final stages and up to publication, he would have corrected many of the errors one meets with in its pages. It would be ungracious to dwell on these overmuch, but truth to tell the book stands in some need of revision on the score of historical accuracy, and sometimes also in the matter of names of the writers who are quoted. It is, furthermore, not improbable that there may be some difference of opinion as to the correctness of the general perspective, and as to the insight into the relative importance of the work and powers of more recent botanists.

But when this has been said, we may recognise that Green has left us a book of permanent value —a lively impression of the services to science, as well as of the personalities of a number of his contemporaries. The way in which he has treated this part of his subject shows him as a genial friend; perhaps somewhat apt to overvalue those for whom he entertained feelings of personal affection, but to no one is he either mean or unkind.

J. B. F.

OBJECTIVE PSYCHOLOGY—PURE AND APPLIED.

Objektive Psychologie oder Psychoreflexologie; die Lehre von den Assoziationsreflexen. By Prof. W. von Bechterew. Autorisierte Uebersetzung aus dem Russischen. Pp. viii+468. (Leipzig and Berlin: B. G. Teubner, 1913.) Price 16 marks.

Psychology and Industrial Efficiency. By Hugo Münsterberg. Pp. xviii+322. (London: Constable and Co., Ltd., 1913.) Price 6*s*. net.

THESE two books, though widely different in origin and aim, agree in exemplifying a single method of psychological investigation: namely, the method which American writers describe by the ungainly term "behaviourism." It is a psychology in which (to quote Prof. von Bechterew) questions of subjective processes, or processes of consciousness, find no place. The

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